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NF1676B TN 30687

Highlights from 4STAR Sky-Scanning Retrievals of Aerosol Intensive Optical Properties from Multiple Field Campaigns with Detailed Comparisons of SSA Reported During SEAC4RS

Abstract:

The 4STAR (Spectrometer for Sky-Scanning, Sun-Tracking Atmospheric Research) instrument combines airborne sun tracking capabilities of the Ames Airborne Tracking Sun Photometer (AATS-14) with AERONET-like sky-scanning capability and adds state-of-the-art fiber-coupled grating spectrometry to yield hyperspectral measurements of direct solar irradiance and angularly resolved sky radiance. The combination of sun-tracking and sky-scanning capability enables retrievals of wavelength-dependent aerosol optical depth (AOD), mode-resolved aerosol size distribution (SD), asphericity, and complex refractive index, and thus also the scattering phase function, asymmetry parameter, single-scattering albedo (SSA), and absorption aerosol optical thickness (AAOT).

From 2012 to 2014 4STAR participated in four major field campaigns: the U.S. Dept. of Energy's TCAP I & II campaigns, and NASA's SEAC4RS and ARISE campaigns. Establishing a strong performance record, 4STAR operated successfully on all flights conducted during each of these campaigns. Sky radiance spectra from scans in either constant azimuth (principal plane) or constant zenith angle (almucantar) were interspersed with direct beam measurements during level legs. During SEAC4RS and ARISE, 4STAR airborne measurements were augmented with flight-level albedo from the collocated Shortwave Spectral Flux Radiometer (SSFR) providing improved specification of below-aircraft radiative conditions for the retrieval.

Calibrated radiances and retrieved products will be presented with particular emphasis on detailed comparisons of ambient SSA retrievals and measurements during SEAC4RS from 4STAR, AERONET, HSRL2, and from in situ measurements.